V.—*Observations on Comets, made at the Observatory of Markree, during the first six Months of the Year* 1846. *By* Edward Cooper, Esq.

Read 20th July, 1846.

THE instruments employed in making the following observations were a comet-seeker and meridian circle, both by the Ertels, of Munich; and as the works of these distinguished artists are little known in this country, and appear to me of very superior construction, a brief notice of them may be acceptable and useful.

The base of the comet-seeker is a strong, conical, brass column, supported by a nearly horizontal tripod, with adjusting screws to set it vertical. There is an azimuthal motion, with clamp and opposing tangent screws, for the purpose of placing the polar axis in the meridian. It bears a strong brass prism, carrying at the eastern side one of Frauenhofer's clocks, for moving the telescope; at the other, a level, to watch the permanence of its position. The southern face of the prism is inclined at an angle approximately equal to the latitude of the place; but, for accurate adjustments, a strong plate of equal dimensions, and to which is attached the brass-work carrying the polar axis, lays over this face, having no actual contact with it. Across the lower part of the face of the prism is attached a small cylindrical steel rod, adapted to which is a groove in the under surface of the strong plate. There are four screws for connecting this plate with the prism; and besides, two pressure screws at the upper part of the plate, by which the upper end can be raised or depressed, while the groove in the under part of the plate works upon the cylindrical steel rod on the face of the prism. The polar axis is of steel, conical, thirteen inches long, and turns steadily and smoothly in a strong tube attached to the plate which I have described, the friction being lessened by a counterpoise, applied as in the Dorpat and Königsberg equatorials. The lower extremity of the axis carries the hour circle, $8\frac{1}{2}$ inches diameter, and

reading with two verniers to four seconds of time. The upper extremity has, first, the apparatus for clock and screw movement; second, the transverse socket, in which the cylindrical declination axis turns. This bears the telescope at one end, 3.8 English inches aperture, and 31 inches focal length. The magnifying power in general use for sweeps is 23, and the field about 2° 8′. The glasses are by Merz, and define very sharply; the lines in its focus are illuminated in the ordinary way. At the other end of this axis is the declination circle, ten inches diameter, and reading with two verniers to minutes of space. Here also are fixed the tangent screw and clamp, the socket bearing a counterpoise merely to equilibrate the telescope, any contrivance for lessening the friction being unnecessary here. It is usual to have an apparatus for illumination of the lines in a dark field, but there are many comets too faint to bear even this, and by many the circular micrometers of Valz and others are used. I, however, prefer one of the ordinary construction, in which bars of steel are substituted for the spider lines, whose edges are exactly parallel. Three of these, being placed equidistant, serve to take the transits by a mean of the disappearance and re-appearance of the object, and two at right angles to them, moveable by micrometric screws, give, in the same way, differences of declination. The breadth of the bars is five minutes of space, and they are always visible without extraneous illumination. The perfect finish of this instrument has excited the admiration of all who have seen it; and I am of opinion, that, with a finer division of its circles, it might be recommended to amateur astronomers as capable of rendering to their science the greatest amount of service which can be obtained by an ordinary sacrifice of time and money. It stands in a small observatory, connected with the circular enclosure of my great equatorial, and level with its summit; it rests on an insulated pillar, and is covered with a moveable dome. The room is entered from the revolving gallery within the enclosure.

The German meridian circles are now well known by the labours of Bessel, Struve, Schumacher, and others. In the British dominions it has been the practice to prefer the combined use of the transit instrument and mural circle, which causes a great increase of expense, and requires two observers. These may not always act simultaneously; and it is seldom that two persons meet whose vision is similarly affected internally from their natural constitutions, or externally from atmospheric influences. The Munich circle does the work of both; its action as

a transit is in no way disturbed by the clamping of the circle. This is cast of bronze, in one piece, which, I conceive, gives it a decided advantage over those which have been made in England, of several pieces of *brass* joined by screws, rendering them more liable to disturbance from changes of temperature or strain. The German scarcely ever exceed three feet in diameter, French measure; the English range in great observatories from five to eight, and, as a consequence of these greater dimensions, are more liable to irregularities of expansion and flexure. It may be said that the larger circle can be divided and read more accurately, but this is not the fact. The divisions of Ertel, Gambey, and Repsold, are of astonishing sharpness, and will bear any magnifying power in the reading microscopes that can be required. My circle, of which I annex engravings, is three feet two inches, English measure, in diameter, and divided to two minutes; these are subdivided by eight microscopes, achromatic, and magnifying about thirty-five times, which are supported by a frame, representing the vernier circle of the earlier instruments, and, like it, connected with a fine level, by means of which any deviation can be measured and corrected. The scale of the level is one second of space, $= \frac{1}{24}$ of a French inch. In the transverse, or axis level, the scale is the same. The continental astronomers seem now to prefer the micrometer microscopes; and in the meridian instrument constructed for Pulkova they are used, four of them being applied to each of the two circles which are carried by the extremities of the axis. I have retained the two circles for the sake of symmetry and equilibrium, but one is merely used as a finder, and for giving the degrees and minutes, while all the microscopes are applied to the other, as I am strongly persuaded that one circle with eight readings gives a better result than two with four. The telescope is of unusual power, having seven inches aperture, and ten feet focal length, being specially destined to determine the places of very small stars. The tube is composed of two frusta of cones, sufficiently strong and *uniform* to be secure from injurious flexure, without the counterpoises formerly applied by Reichenbach; but as a means of guarding against its influence, the object glass and eye apparatus can be applied indifferently at either end. Of course, the circles and micrometer frame are counterpoised. The field of view can be illuminated in the usual way, by a light placed at the end of the axis which carries the setting circle, and which is perforated for that purpose; or the lines can be illuminated, in a dark field, by openings in the opposite sides of an

eye end, which are covered with semi-transparent glass. This latter contrivance has been found of essential service in the observation of faint objects. The results from the separate observations speak for the performance of the instrument.

The observations with comet-seeker were in all cases taken with the steel bar micrometer eye-piece, power 30. The eye-piece commonly used in seeking for objects has a power of 23, as mentioned above. A power as low as 17 can be applied; but it has been found to admit too much extraneous light, and, on the whole, not to be so satisfactory. The places of comets were, as usual, determined by differences from some fixed star in the field, the circles of the instrument being merely used for identification of the star. The small stars observed with meridian circle were always taken in a dark field, with illuminated lines. The eight microscopes were read in most cases: when, however, want of time obliged us to take opposite readings with two microscopes, a correction was applied to reduce their mean to the mean of all.

In reference to the table on page 119, after the numbers for reference, are given in the second columns the mean right ascensions and declinations for 1st January, 1846; in the third, the annual precessions in right ascension and declination; the four following contain the constants for determining the *apparent* places of the stars by the methods now universally practised by astronomers; the eighth column gives the number of observations; the ninth of Table I., the initials of the observers, myself and Mr. Graham; the results of the separate observations have been annexed in the last column, when the same star was observed more than once. The transit corrections were determined from high and low stars, assuming the Nautical Almanac places to be correct. As the observations for this purpose were generally made by Mr. Graham, it was found necessary to apply a correction of $0^s.40$ for personal equation to the transits taken by me, viz.:

E. J. C.'s clock correction = A. G.'s$-0^s.40$.

The separate results, from the mean of which the position of the polar point on the circle was determined, are subjoined. These are generally by A. G. The refraction tables used here are those by Dr. Robinson, of Armagh.

The succeeding tables require little explanation after what has been said. The longitude of this observatory from Greenwich has been taken at $+ 0^h.\ 33^m.\ 48^s.4$. It has been judged most convenient for all to give the mean Greenwich

time. The apparent right ascension and declination are determined by the differences from the *apparent* places of the compared stars on the night of observation. The sources from which were derived the places of the compared stars, are referred to in the last column of all, except that of Gambart's or Biela's Comet, where the fourth column gives this information. All the stars with Brorsen's Comet, of February 26th, were determined by the meridian circle. The dates without places signify that we have made observations, but have not yet the stars of comparison.

EDWARD J. COOPER.

MARKREE CASTLE,
July 3, 1846.

	Mean Right Ascension, Jan. 1, 1846.	Ann. Prec.	Logarithms of				No. of Obs.	Observer.	Results of separate Observations.
			a	*b*	*c*	*d*			
	h. m. s.	s.							h. m. s.
1	23 2 50.55	+ 2.355	+ 9.1881	— 8.5942	+ 0.3720	+ 9.1462	1	E.J.C. *	
2	23 31 37.445	2.769	+ 9.1389	— 8.2339	+ 0.4424	+ 9.0819	2	A.G. *	23 31 37.50 37.39
3	23 31 37.30	2.769	+ 9.1394	— 8.2344	+ 0.4423	+ 9.0825	1	E.J.C.	
4	23 35 36.52	2.790	+ 9.1320	— 8.2056	+ 0.4456	+ 9.0727	1	A.G.	
5	23 38 4.94	2.843	+ 9.1327	— 8.1147	+ 0.4537	+ 9.0734	1	A.G.	
6	23 49 49.775	2.971	+ 9.1137	— 7.7612	+ 0.4729	+ 9.0476	2	EJ.C. & A.G.	23 49 49.80. E.I.C. 49.75. A.G.
7	23 54 27.43	3.015	+ 9.1228	— 7.5059	+ 0.4793	+ 9.0596	2	E.J.C. & A.G.	23 54 27.515. E.I.C. 27.344. A.G.
8	23 54 28.68	3.016	+ 9.1205	— 7.5018	+ 0.4794	+ 9.0566	1	E.J.C.	
9	0 2 27.56	3.092	+ 9.0798	+ 7.1109	+ 0.4902	+ 8.9999	2	A.G.	0 2 27.56 27.555
10	0 3 34.885	+ 3.100	+ 9.0664	+ 7.2604	+ 0.4914	+ 8.9803	1	E.J.C.	

	Mean Declination, Jan. 1, 1846.	Ann. Prec.	Logarithms of				No. of Obs.	Results of separate Observations.
			a'	*b'*	*c'*	*d'*		
	h. m. s.	s.						h. m. s.
1	+ 65 13 56.04	+ 19.43	+ 9.6085	+ 9.9444	+ 1.2886	+ 9.3924	1	*
2	61 16 56.415	19.90	+ 9.5008	+ 9.9396	+ 1.2989	+ 9.0916	2	* 61 15 56.40 56.43
3	61 19 0.59	19.90	+ 9.5006	+ 9.9398	+ 1.2989	+ 9.0916	1	
4	60 43 6.26	19.94	+ 9.4212	+ 9.9381	+ 1.2997	+ 9.0711	1	
5	60 44 7.69	19.96	+ 9.4705	+ 9.9387	+ 1.3002	+ 8.9800	1	
6	59 9 59.72	20.03	+ 9.4158	+ 9.9334	+ 1.3018	+ 8.6470	2	59 9 59.69. E.J.C. 59.75. A.G.
7	59 50 48.86	20.05	+ 9.3782	+ 9.9367	+ 1.3021	+ 8.3830	2	59 50 52.44. E.J.C. 45.29. A.G.
8	59 40 12.18	20.05	+ 9.3800	+ 9.9359	+ 1.3021	+ 8.3812	1	
9	56 18 28.71	20.05	+ 9.3651	+ 9.9201	+ 1.3022	— 8.0311	2	56 18 27.99 29.43
10	+ 55 6 23.94	+ 20.05	+ 9.3718	+ 9.9139	+ 1.3022	— 8.1939	1	

RESULTS FOR POLAR POINT ON MERIDIAN CIRCLE:

1846.—April 14. Polaris, ... 144° 10′ 34″.01
15. *α* Cassiop. SP. 32.98
Polaris SP. 32.02
16. *γ* Ursa Mag. 31.60
α Cassiop. SP. 31.67
Polaris, ... 32.07
17. Do. 31.95
1846.—April 18. Polaris, ... 33.07
22. Do. 32.32
24. Polaris SP. 33.22
27. Do. 34.10
Do. 32.53
Mean . . . 144° 10′ 32″.63

* 2 and 3 are probably the same star, supposing an error of 2′ in reading the index of 3.

De Vico's Comet of January 24, 1846.

Mean Time, Greenwich.	Apparent Right Ascens.	Apparent Declination.	Observers.	Instrument.	Compared Star.	Observations.
	h. m. s.	h. m. s.				h. m. s.
Feb. 17.37627	4 35 57.06	+ 19 34 12	E.J.C.	Cometen-Sucher.	Piazzi Hora iv. No. 119	
24.37669	4 18 23.50	25 30 32	do.	do.	Bessel Zone 396 =	4 49 29.29
25.36796	4 50 17.30	26 16 2	do.	do.	Do. do. =	4 51 32.23
26.29228	4 52 1.79	26 58 53	do.	Meridian Circle.		
28.	. . . .	. . . .	do.	Cometen-Sucher.		
March 4.37843	5 4 30.02	31 12 57	do.	do.	Bessel Zone 517 =	5 4 40.20
7.38717	5 11 3.26	33 4 49	A.G.	do.	Do. 518 = Comet barely visible.	5 8 4.08
11.	. . . .	. . . .	E.J.C.	do.		
16.37191	5 32 11.62	37 48 5	do.	do.	Hist. Celeste, p. 309 = Last degree of visibility.	5 28 32
23.	. . . .	. . . .	do.	do.		
24.	. . . .	. . . .	do.	do.		
26.48367	5 58 13.00	41 50 54	do.	do.	Bessel Zone 516 =	5 5 17.81
28.45201	6 3 29.49	42 30 0	do.	do.	Do. do. =	6 4 41.44
30.44245	6 9 0.83	43 7 34	do.	do.	Do. 611 =	6 8 39.95 6 12 39.10
31.44372	6 11 45.73	43 26 8	do.	do.	Do. do. =	6 12 39.10 6 13 5.50
April 17.	. . . .	. . . .	do.	Equatorial.		

Note.—There is a discrepancy in the declination observations of 30th and 31st March, the latter especially, which shews that they are not to be relied on.

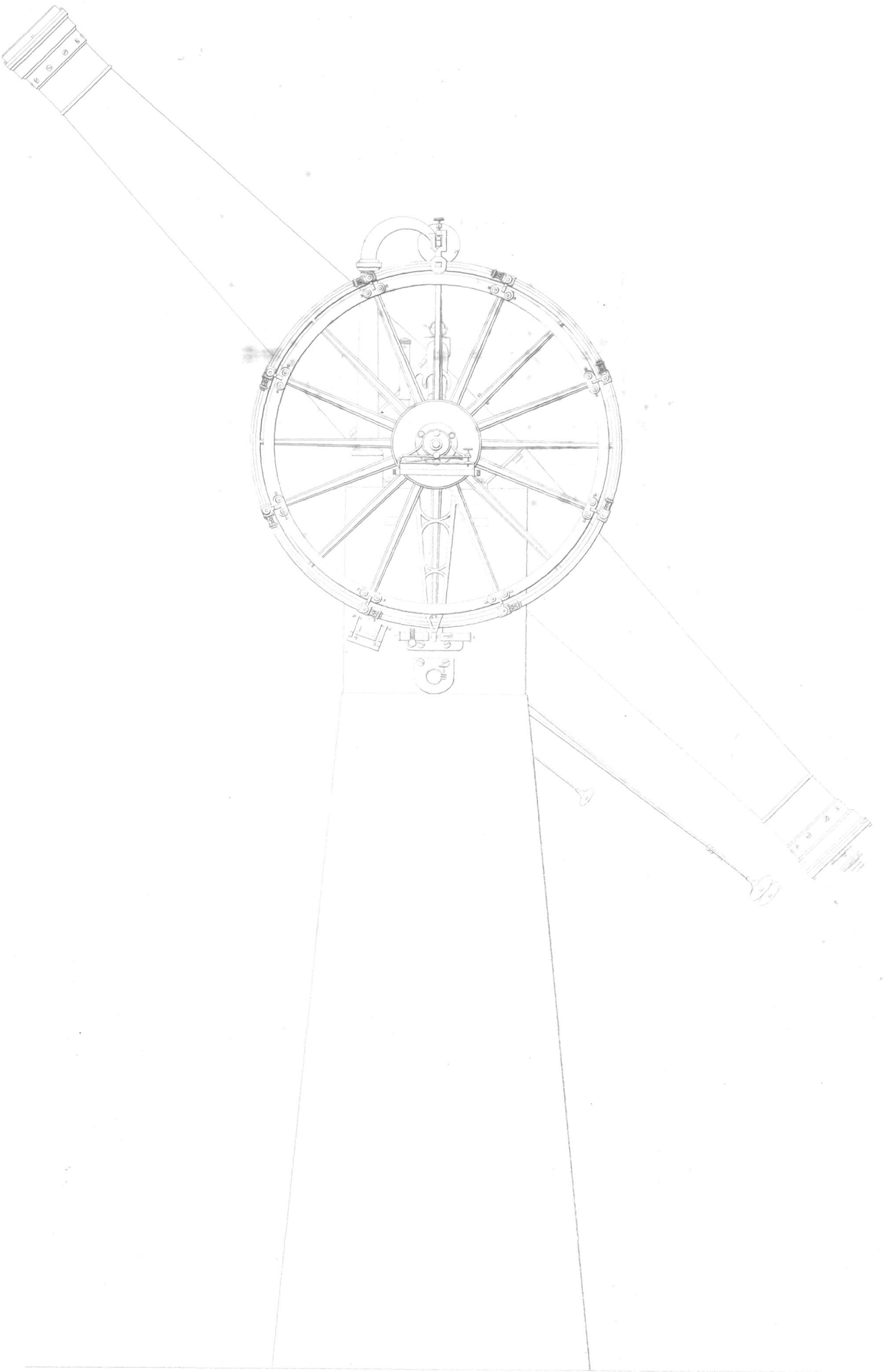
Feb. 17.—Second observation this night somewhat uncertain, on account of a minute star at one time very near to nucleus.

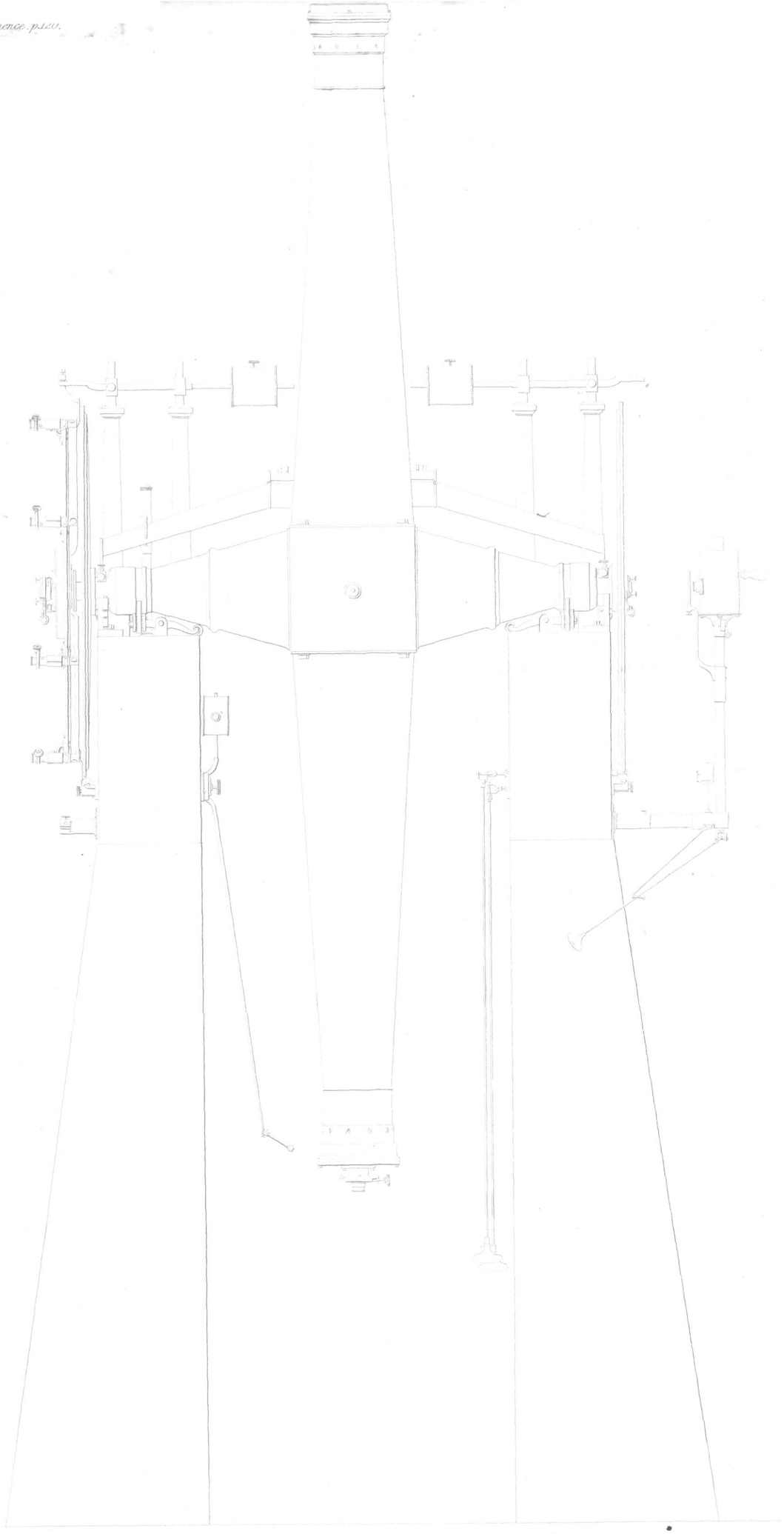
Feb. 25.—Very hazy; observation not to be depended on.

March 7.—Comet barely visible.

March 11.—Faint to the last degree.

April 23.—Had disappeared.





GAMBART'S OR BIELA'S COMET.

Mean Time, Greenwich.	Apparent Right Ascen.	Apparent Declination.	Compared Star.	M. T. Greenwich.	Distance of Companion.	Observers.	Instrument.
	h. m. s.		h. m. s.		In α. In δ.		
Feb. 24.34986	2 45 39.52	— 6° 8′ 54″	B. Z. 264 = 2 41 46.57	.34184	— 216″.2 + 216″.5	E. J. C.	Cometen-Sucher.
25.33500	2 51 26.70	— 7 18 50.5	Do. 264 = { 2 53 34.92 / 2 51 4.54 }	.32523	— 226.2 + 400.2	do.	do.
28.36281	3 9 53.01	— 8 14 38	Do. 264 = 3 7 38.80	.36339	— 242.1 + 441.6	do.	do.
Mar. 4.32603	3 35 58.61	— 9 30 15	Do. 267 = 3 31 43.81	.33947	— 317.5 + 412.1	do.	do.
6.34041	3 50 7.44	—10 9 26	Do. 267 = 2 48 15.46	. .	Companion not visible.	A. G.	do.
24.	. . .	. . . .	. . . . .	.431	— 597.0 + (Cannot depend on this. By chordal transits.)	E. J. C.	Equatorial.
25.36487	6 27 25.18	—14 30 38.5	Do. 263 = 6 23 19.13	. .	Companion not visible in C. S., and very faint in Equatorial.	do.	Cometen-Sucher.
27.	. . .	Not observed, owing to clouds.	. . . . .	. .	Companion not visible in C.S.; clouds prevented use of Equatorial.	do.	do.
28.36819	6 53 5.26	—14 35 0.5	{ Hist. Celeste, 277, } 6 50 8.50	.41694	— 682.0 + 484.0	do.	do.
. . . .	. . .	. . . .	. . . . .	. .	The observation of companion was made by chordal transits.	do.	Equatorial.
31.	. . .	. . . .	. . . . .	. .	Companion not seen.	do.	Cometen-Sucher.
Apr. 16.	. . .	. . . .	. . . . .	. .	Companion not seen. Place obtained only by diagram.	do.	Equatorial.

Notes. Feb. 24.—Comet S. following has the largest coma.

March 7.—A. G. searched for the comet but without success.

March 24.—S. following brighter than it has yet appeared, with strong concentration of light in centre. The N. preceding of as great diameter as the other, but equable throughout as to light, and was very faint; indeed extremely like Nebula No. 112, Fig. 38, of Sir John Herschel's Catalogue.

March 25.—Nebulosity immensely diffused, and a bright nucleus. The N. preceding was discernible and no more. The observation of S. following was easy.

DE VICO'S COMET OF FEBRUARY 20, 1846.

Mean Time, Greenwich.	Apparent Right Ascens.	Apparent Declination.	Observers.	Instrument.	Compared Star. Remarks.
	h. m. s.				h. m. s.
Mar. 19.39676	0 49 17.62	+31°35′2.25″	A. G.	Cometen-Sucher.	Hist. Celeste, p. 350 = 0 45 41.50 Bessel Zone 458 = 0 48 44.76
23.	. . . .	. . . .	E. J. C.	do.	
26.	. . . .	. . . .	A. G.	do.	
28.35537	0 38 31.54	+40 9 9.46	E. J. C.	do.	ν Andromedæ.
31.37923	0 34 26.65	+42 44 10.50	do.	do.	Bessel Zone 443 = 0 33 2.30 Do. do. 444 = 0 32 55.61
April 16.54966	0 7 29.06	+54 59 26	do.	do.	Hist. Celeste, p. 373 = 0 0 48.71
18.46609	0 3 21.48	+56 19 44	do.	do.	Do. do. 370 0 0 4.73 0 1 18.35
23.	. . . .	. . . .	do.	Equatorial.	
28.	. . . .	. . . .	do.	do.	

Notes. March 28.—Nebula of Andromedæ in the true N. W. part of the field, Comet in S. E.; the combination beautiful; tail of comet extremely well shewn, extending over three-fourths of field of view.

April 23.—Comet round, but irregular in edge, shewing no portion of tail.

BRORSEN'S COMET OF FEBRUARY 26, 1846.

Mean Time, Greenwich.	Apparent Right Ascens.	Apparent Declination.	Observers.	Instrument.	Compared Star. Remarks.
	h. m. s.				
Mar. 23.39022	0 5 1.42	+ 55° 4′ 33″	E. J. C.	Cometen-Sucher.	$\alpha =$ 0h 3m 34s 715 } By Mer. Circle. $\delta =$ + 55° 6′ 27″.47 } E. J. C. 1 Obs.
24.37482	23 59 45.23	+ 56 30 27	do.	do.	$\alpha =$ 0h 2m 27s 37 } By do. A. G. $\delta =$ + 56° 18′ 32″.07 } 2 Obs.
26.46009	23 47 7.76	+ 59 26 25	do.	do.	$\alpha =$ 23h 49m 49s 44 } By do. A. G. & $\delta =$ + 59° 10′ 2″.33 } E. J. C. 2 Obs.
27.46456	. . . .	. . . .	do.	do.	
28.39254	23 33 31.93	+ 62 1 45	do.	do.	$\alpha =$ 23h 31m 37s 00 } By do. E. J. C. $\delta =$ + 61° 16′ 57″.93 } 1 Obs.
31.42403	23 7 38.46	+ 65 44 26	do.	do.	$\alpha =$ 23h 2m 49s 88 } By do. E. J. C. $\delta =$ + 65° 13′ 55″.73 } 1 Obs.

BRORSEN'S COMET OF APRIL 30, 1846.

Mean Time, Greenwich.	Apparent Right Ascens.	Apparent Declination.	Observers.	Instrument.	Compared Star.	Remarks.
	h. m. s.					h. m. s.
May 18.	. . . .	. . . .	E.J.C.	Cometen-Sucher.		
20.	. . . .	. . . .	do.	do.		
27.	. . . .	. . . .	A.G.	do.		
28.48264	6 59 11.15	+42° 8′ 30″	do.	do.	Hist. Celeste, p. 208,	6 55 7.4
29.47280	7 0 0.50	41. 24 41	do.	do.	Bessel, Zone 516,	6 56 59.62
30.44243	7 0 37.61	40 42 39	do.	do.	Bessel, Zone 509,	6 59 56.50
June 1.47706	7 1 22.24	39 25 23	do.	do.	63 Aurigæ	
3.48291	7 1 28.84?	38 15 2?	do.	do.	Hist. Celeste, p. 209,	6 58 57.3
4.48782	7 1 23.50	37 42 19	do.	do.	Do. p. 209,	6 55 27.5

May 18.—Very bright; kidney shaped, shewing sectors, somewhat similar to Halley's Comet in 1835.

May 20.—About as bright as the Nebula in Andromeda.

May 29.—Comet well shewn. Four stars visible.

June 1.—Comet barely visible.

June 3.—Comet and star both very faint. The place of the compared star is determined on the supposition that $6^h\ 55^m\ 57^s.3$ in the Histoire Celeste, should be $6^h\ 57^m\ 57^s.3$.